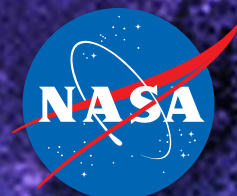
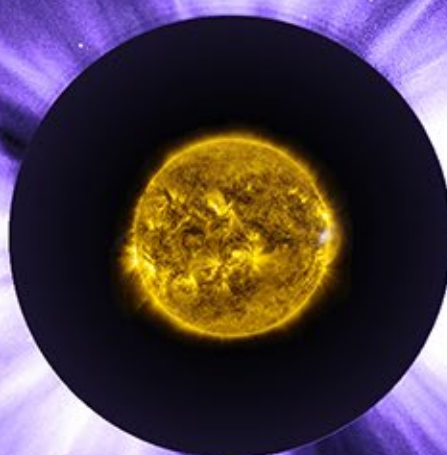


National Aeronautics and Space Administration



GoddardView

Volume 9 Issue 16
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THE FATE OF COMET ISON

GoddardView

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On the cover: Comet ISON swoops around the sun and through Scorpius. This composite merges an SDO AIA 171 sun image (Nov. 28, 2214 UT), SOHO C2 (2036 UT) and C3 (2030 UT) images, and a Digitized Sky Survey view of the sky in northern Scorpius. Image credit: NASA/ESA/SOHO, NASA/SDO, DSS, and Francis Reddy

GoddardView

Goddard View is an official publication of NASA's Goddard Space Flight Center. *Goddard View* showcases people and achievements in the Goddard community that support Goddard's mission to explore, discover, and understand our dynamic universe. [Goddard View](#) is published weekly by the Office of Communications.

News items for publication in *Goddard View* must be received by noon Wednesday of each week. You may submit contributions to the editor via e-mail at john.m.putman@nasa.gov. Ideas for new stories are welcome but will be published as space allows. All submissions are subject to editing.

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THE WEEKLY



GPM to Tanegashima Space Center
NASA's GPM Core Satellite arrives at its launch site at Tanegashima Island Space Center in Japan where it will be prepared for launch in early 2014 on an H-IIA rocket. For more pictures from GPM's journey, click on the picture.

Sounding Rocket to Peek at Venus

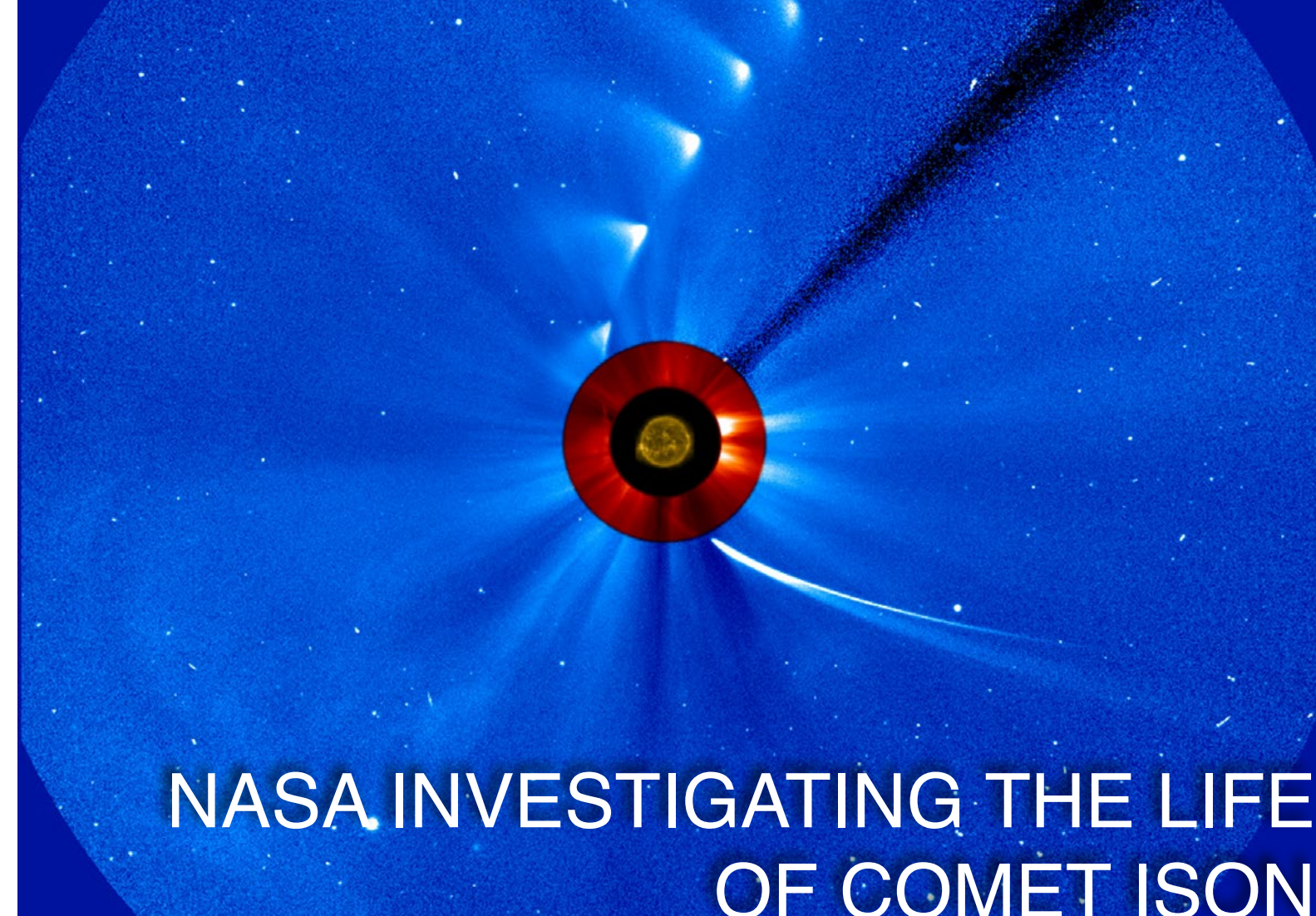
The Venus Spectral Rocket Experiment launched successfully on November 27 from White Sand Missile Range. VeSPR will study the present day escape of water from the atmosphere of Venus and relate it to the past abundance of water on Venus. To learn more, click on the image.



New Digital Resources Teach Students About NASA's MMS Mission A new set of NASA resources called iMAGiNETICspace is helping educators teach science and engineering concepts to middle school students in a fun, interactive way. iMAGiNETICspace is a digital age NASA product that provides direct access to rich on-line multi-media content. For more information, click on the image.

Enrich Your Child's Holidays with STEM Toys

A recent GCDC Lunch and Learn reviewed toys and games that will enrich your child's learning in science, technology, engineering, and mathematics. Click on the image for more information and suggestions.



NASA INVESTIGATING THE LIFE OF COMET ISON

By: Karen C. Fox

After several days of continued observations, scientists continue to work to determine and to understand the fate of Comet ISON. There's no doubt that the comet shrank in size considerably as it rounded the sun and there's no doubt that something made it out on the other side to shoot back into space. The question remains as to whether the bright spot seen moving away from the sun was simply debris, or whether a small nucleus of the original ball of ice was still there. Regardless, it is likely that it is now only dust.

Comet [ISON](#), which began its journey from the Oort Cloud some 3 million years ago, made its closest approach to the sun on Nov. 28, 2013. The comet was visible in instruments on NASA's Solar Terrestrial Relations Observatory and the joint European Space Agency/NASA Solar and Heliospheric Observatory via images called coronagraphs. Coronagraphs block out the sun and a considerable distance around it, in order to better observe the dim structures in the sun's atmosphere, the corona. As such, there was a period of several hours when the comet was obscured in these images, blocked from view along with the sun. During this period of time, NASA's Solar Dynamics Observatory could not see the comet, leading many scientists to surmise that the comet had disintegrated completely. However, something did reappear in SOHO and STEREO coronagraphs some time later—though it was significantly less bright.


Whether that spot of light was merely a cloud of dust that once was a comet, or if it still had a nucleus—a small ball of its original, icy material—intact, is still unclear. It seems likely that as of Dec. 1, there was no nucleus left. By monitoring its changes in brightness over time, scientists can estimate whether there's a nucleus or not, but our best chance at knowing for sure will be if the Hubble Space Telescope makes observations later in December 2013.

Regardless of its fate, Comet ISON did not disappoint researchers. Over the last year, observatories around the world and in space gathered one of the largest sets of comet observations of all time, which should provide fodder for study for years to come. The number of space-based, ground-based and amateur observations was unprecedented, with twelve NASA space-based assets observing over the past year. ■

Above: Comet ISON comes in from the bottom right and moves out toward the upper right, getting fainter and fainter, in this time-lapse image from the ESA/NASA Solar and Heliospheric Observatory. The image of the sun at the center is from NASA's Solar Dynamics Observatory. Image credit: ESA/NASA/SOHO/SDO/GSFC. For more images, click on the picture.

NASA HELPS LAUNCH STUDENT-BUILT SATELLITES AS PART OF CUBESAT LAUNCH INITIATIVE

By: Joshua Buck



“...enabling an acceleration of flight-qualified technology.”

NASA is beginning to receive confirmation that 11 small cubesat research satellites, including the first developed by high school students, launched into space November 19 from the Virginia coast are operating as planned.

The cubesats were included as auxiliary payloads aboard a U.S. Air Force Minotaur 1 rocket that lifted off from the Mid-Atlantic Regional Spaceport at NASA's Wallops Flight Facility at 8:15 p.m. EST. The cubesats, NASA's fourth [Educational Launch of Nanosatellite](#) mission, deployed from their protective cases into Earth's orbit about 20 minutes after liftoff.

As the miniature satellites come online, the teams responsible for them are beginning to receive signals. Although it could take several more days for full confirmation, all of the cubesats appear to be doing well in their new home in low-Earth orbit. The teams are responsible for confirming activation and normal operations of the cubesats.

“Cubesats offer our best and brightest young minds the opportunity to discover the excitement of space exploration while confronting the tough technology and engineering challenges surrounding spaceflight,” said Leland Melvin, NASA's associate administrator for education in Washington. “By opening the space frontier to a new generation of scientists and engineers, we encourage students to pursue careers in science, technology, engineering and mathematics.”

Cubesats are a class of research spacecraft called nanosatellites. The cube-shaped satellites measure about four inches on each side, have a volume of about one quart and weigh less than three pounds. Cubesat research addresses science, exploration, technology development, education or space missions.

“The advancements of the cubesat community are enabling an acceleration of flight-qualified technology that will ripple through the aerospace industry,” said Jason Crusan, director of NASA's Advanced Exploration Systems Division, which oversees the CubeSat Launch Initiative. “Our future missions will be standing on the developments the cubesat community has enabled.”

Cubesats from nine universities, a NASA center and a high school were launched. The TJ3Sat from Thomas Jefferson High School for Science and Technology of Alexandria, Va., contains a voice synthesizer module that will take written phrases in the form of code and produce a phonetic voice reading on the satellite's downlink frequencies. TJ3Sat is the first NASA-sponsored cubesat developed by high school students.

Also sent into orbit was PhoneSat 2.4, a second-generation smartphone cubesat mission sponsored by NASA's Space Technology Mission Directorate. Phonesat 2.4 will test the smartphone's capability as communication technology for nano-satellites and as hardware to manage pointing, taking images and software execution. [PhoneSat 2.4](#) has several improvements over the previous mission, including a two-way radio to enable command of the satellite from the ground, solar arrays to enable it to be operational for up to a year, and a system for attitude control.

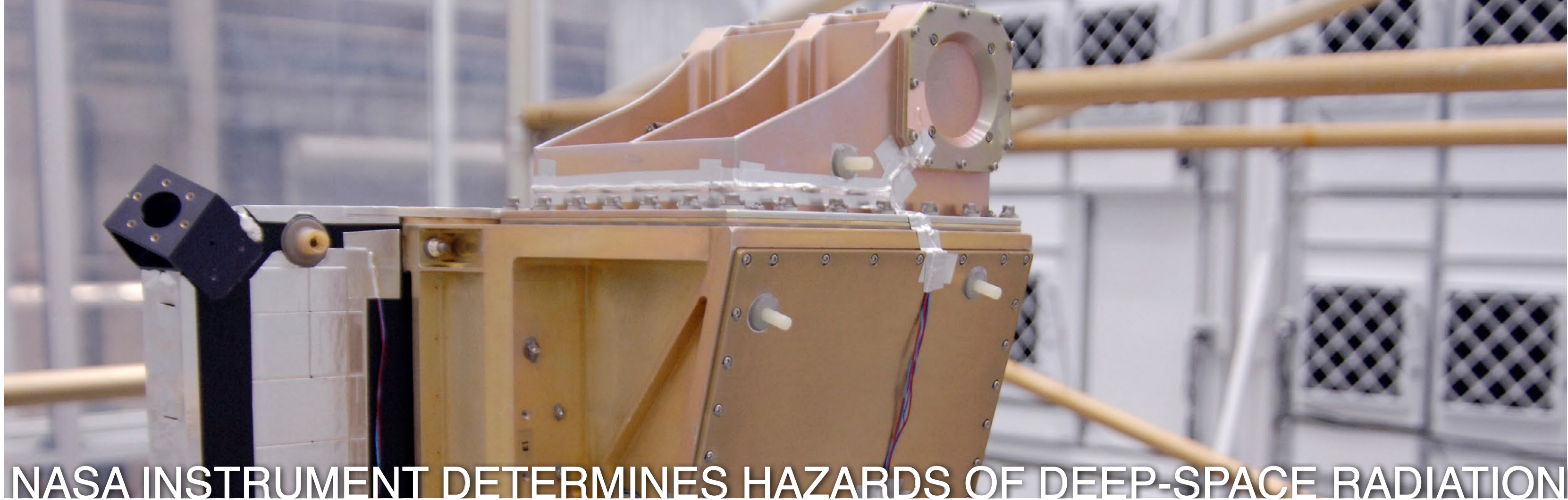
More than 300 students from the following institutions were involved in preparing the 11 cubesats:

- Thomas Jefferson High School
- Drexel University, Philadelphia, in collaboration with the United States Naval Academy
- NASA's Ames Research Center, Moffett Field, Calif.
- St. Louis University, St. Louis
- University of Alabama, Huntsville, Ala.,
- University of Florida, Gainesville, Fla.
- University of Hawaii, Honolulu
- University of Kentucky, Lexington, Ky., in collaboration with Morehead State University, Morehead, Ky.
- The University of Louisiana, Lafayette, La.
- University of New Mexico, Albuquerque, N.M.
- Vermont Technical College, Randolph Center, Vt.

The launch also marks the first flight of the Nanosatellite Launch Adapter System, a satellite deployment system built by Ames. NLAS is capable of carrying approximately 100 pounds of secondary payloads into orbit, and can accommodate various configurations of cubesats.

ELaNa missions, conducted under [NASA's CubeSat Launch Initiative](#), give students, teachers and faculty hands-on experience developing flight hardware by providing access to a low-cost avenue for research. Since its inception in 2010, the CubeSat Launch Initiative has selected more than 90 cubesats from primarily educational and government institutions around the United States. NASA chose these miniature satellites from respondents to public announcements for the agency's CubeSat Launch Initiative. ■

Opposite: A Minotaur I rocket carrying, among other payloads, 11 small cubesat research satellites as part of NASA's fourth Educational Launch of a Nanosatellite program, lifts off from Virginia's Mid-Atlantic Regional Spaceport Pad 0B at NASA's Wallops Flight Facility at 8:15 p.m. EST Nov. 19. Photo credit: NASA/Wallops/Chris Perry



NASA INSTRUMENT DETERMINES HAZARDS OF DEEP-SPACE RADIATION

By: Paul Gabrielsen

Deep-space radiation is a significant danger for interplanetary human spaceflight. But now an instrument on NASA's Lunar Reconnaissance Orbiter has learned more than ever before about the high-energy hazards at and around the moon. New findings from the Cosmic Ray Telescope for the Effects of Radiation were published in the journal *Space Weather*.

"We've never had a detector that's been as good at understanding the effects of radiation through tissue-equivalent material as the CRaTER detector," said Nathan Schwadron, CRaTER principal investigator at the University of New Hampshire, Durham. "These publications document, wall-to-wall, different effects and instrument responses with some of the best long-term measurements ever made of radiation in deep space."

Human exploration missions will rely on these measurements to know how much radiation to expect in deep space, and how best to shield against this radiation. CRaTER observes how radiation interacts with its unique tissue-equivalent plastic detector array, which mimics radiation doses within the human body. Now in an extended mission, the instrument has also encountered a few unusual sources of radiation—sources as close as the moon's surface and as vast as the cosmos itself.

Radiation in deep space comes from cosmic rays, from the solar wind and from solar energetic particles emanated during a solar storm. Particles from these sources rocket through space. Many can pass right through matter, such as our bodies. So-called ionizing radiation knocks electrons off of atoms within our bodies, creating highly reactive ions.

Within Earth's protective atmosphere and magnetic field, we receive low doses of background radiation every day. The radiation hazards astronauts face are serious, yet manageable thanks to research endeavors such as the CRaTER instrument.

CRaTER measures realistic human radiation doses at the moon using a unique material called tissue-equivalent plastic. Two pieces of this plastic, roughly two inches and one inch thick, are separated by silicon radiation detectors. The TEP-detector combo measures how much radiation may actually reach human organs, which may be less than the amount that reaches the spacecraft.

"Tissue-equivalent plastic gives us an idea of the self-shielding of the body," said Larry Townsend, of the University of Tennessee, Knoxville. "The radiation spectrum at the organs is not going to be the same as the radiation spectrum that's outside the spacecraft."

Townsend notes that CRaTER's observations have come at a time when solar activity has been unusually quiet. The solar wind disperses some galactic cosmic rays, but in the current solar lull, more of these rays are able to bombard Earth and the moon. CRaTER, which launched aboard LRO with six other instruments in 2009, has been able to monitor the lunar environment as solar activity has declined.

"They're lower-level exposures," Townsend said, of galactic cosmic rays, "but they're damaging in the sense that the particles are highly charged and heavy, and they create a lot of damage when they're going through the body."

Lab tests suggested that materials rich in hydrogen, such as some plastics, may shield against these heavy particles, said Cary Zeitlin of the Southwest Research Institute, San Antonio, Texas. "The tissue-equivalent plastic in CRaTER has fairly high hydrogen content," he said, "so it lets us test this hypothesis using data from deep space. And it turns out that plastic really is a good shield against these particles, significantly better than aluminum."

LRO's unofficial motto is "exploration enables science, and science enables exploration." LRO launched as an exploration mission, a forerunner for humanity's return to the moon. But after completing its primary mission in 2010, LRO has become a powerful instrument for lunar and planetary science. CRaTER is an active participant in this scientific study, discovering a previously unmeasured source of hazardous radiation emanating from the moon itself.

This radiation comes from the partial reflection of galactic cosmic rays off the moon's surface. Galactic cosmic ray protons penetrate as much as three feet into the lunar surface, bombarding the material within and creating a spray of secondary radiation and a mix of high-energy particles that flies back out into space. This galactic cosmic ray albedo, which may interact differently with various chemical structures, could provide another method to remotely map the minerals present at the moon's surface.

CRaTER directly measured the proton component of the moon's radiation albedo for the first time, said Harlan Spence, deputy principal investigator at the University of New Hampshire. The TEP radiation detector measures various components of radiation separately, which enables CRaTER

to, in Spence's words, "unfold" the energy spectrum of the radiation albedo. This result, he said, illustrates the value of combining exploration and science in spaceflight. "If we had been on a different science-oriented mission, we probably would've developed a different instrument," Spence said. "In fact, we probably never would have flown TEP."

Looking toward future missions, Schwadron and his colleagues are developing a next-generation radiation dose detector, drawing on CRaTER's design. The detector, called Dose Spectra from Energetic particles and Neutrons builds on CRaTER's ability to break radiation down into its components and assess the doses resulting from each part of the radiation spectrum. Human exploration will benefit, Schwadron said, from this "very specific information about the spectrum of radiation we need to shield against."

Spence, who served as the instrument's principal investigator through the primary mission, said he's proud of his team's foresight to equip CRaTER with the capability to accomplish its mission and continue to pursue great science.

"We had hopes and aspirations," he said, "but we didn't think we would be able to reap as much from those data as we are. Exploration now is enabling science." ■

Above: LRO's CRaTER instrument, prior to its installation on the spacecraft. Photo credit: NASA/Goddard/Debbie McCallum



The state of Maryland and NASA's Goddard Space Flight Center in Greenbelt, Md., have embarked on a new partnership effort, the main goal of which is to attract high technology companies to Maryland, which in turn will enable both future missions of NASA and the economic future of Maryland.

The agreement, signed by U.S. Sen. Barbara Mikulski, Maryland Gov. Martin O'Malley and Goddard Space Flight Center Director Chris Scolese will help in several ways. Goddard will obtain specialized skills and technologies needed for its numerous mission applications. It will help the center engage in technical exchanges with local technology companies regarding new trends, theories, techniques and challenges in aerospace technology. Finally, it will provide an opportunity for the development of local educational and labor resources specific to Goddard's needs.

"Innovative partnerships like this are helping NASA make the most of the agency's extraordinary expertise and the goals we share with industry to create good jobs and a bright future for our nation's space program," said NASA Administrator Charles Bolden. "Goddard plays a critical role in our exploration of space and study of our home planet, and this new agreement with Governor O'Malley and Senator Mikulski will stimulate economic growth and technological breakthroughs that will help NASA reach farther into the solar system and beyond it."

O'Malley, describing the benefits of this agreement said, "Maryland is home to some of the most gifted minds in space and technology. This longstanding partnership between the state and Goddard—now formalized—is about creating family-supporting jobs and expanding opportunity

for local businesses, building a stronger future for Maryland's innovation economy."

"Technology transfer is essential to making sure that Maryland's economy thrives and succeeds," said Mikulski, chairwoman of the Commerce, Justice and Science Appropriations Subcommittee that funds NASA. "As chairwoman, I'm looking out for the long-range needs of the nation, and I believe that science and innovation are the keys to what make our economy moving and our country great. But I've always got Maryland at heart, and I've always been on Goddard's side. With the knowledge of NASA and the know-how of Maryland's private sector we can bring innovation from the edges of the universe to the forefront of our local economy—creating jobs today and jobs tomorrow."

"Today's agreement between Maryland and NASA's Goddard Space Flight Center is an important step toward expanding aerospace business and creating jobs in our state," said U.S. Rep. Steny Hoyer. "Our aerospace assets are among the best in the world, and this new tech transfer effort will support NASA's critical mission while providing opportunities for businesses to expand technology, research and development, and advanced manufacturing in the region. I will continue to urge my colleagues in Congress to support these efforts by replacing the irrational sequester cuts policy and by passing Make It In America jobs legislation, which will help Maryland's aerospace businesses compete, grow, and create well-paying jobs." ■

Above: From left, Goddard Center Director Chris Scolese, U.S. Senator Barbara Mikulski and Maryland Governor Martin O'Malley sign a memorandum of understanding promoting technology transfer. Photo credit: NASA/Goddard/Debora McCallum

MARYLAND, NASA BEGIN TECHNOLOGY TRANSFER PARTNERSHIP

By: Edward Campion



On November 15, the Godard Child Development Center's kindergartener students, along with the Code 250 Environmental Division, worked together to participate in "I Want to Be Recycled." The groups joined thousands of local organizers holding recycling events across the country to celebrate America Recycles Day, the only nationally recognized day dedicated to promoting and celebrating recycling in the United States.

According to the U.S. Environmental Protection Agency, the average American recycles or composts 1.53 pounds a day. Collectively, the United States produces approximately 250 million tons of trash a year, and recycle and compost nearly 35 percent of that total.

Keep America Beautiful's new national advertising campaign, in partnership with the Ad Council, aims to inspire individuals to recycle more by illustrating what "garbage" can become when it is recycled. "Having students participate in America Recycle Day activities is one of the many aspects of our curriculum aimed at helping them to become more environmentally conscious citizens. With respect to this approach, we teach the students to appreciate the beauty in our environment through activities such as nature walks, bird watching and gardening," said Syretha O. Storey, director of the [Goddard Child Development Center](#).

During the two-day event, Elycia Chew's kindergarten class was encouraged by the Environmental Division to recycle more by providing an interactive opportunity to learn what can and can't be recycled in their community. In this activity, the students had one day to gather all material that would normally be thrown away. On day two, items based on what can and can't be recycled were divided and explained. The "I Want to Be Recycled" event encouraged the students to recycle more.

Highlights from the kindergarten class included five-year-old Eric Ammond, "I love to recycle now! After I recycle stuff I don't need, I use the rest to build spaceships." Liliana Jones prefers to use recycled items to build houses, cut out things for her dolls, and to make toys for her cat, Oscar.

The event concluded with a small concert from the class. The students sang about why they felt recycling was so important, singing lyrics, "Reduce, Reuse, Recycle are words that we all know. We have to save our planet so that we can live and grow! We may be only children, but we can try, you see. Reduce, Reuse, Recycle it starts with you and me!"

The Environmental Division's recycling initiative with GCDC has existed since 2002. Since America Recycles Day's inception in 1997, communities across the country have participated on November 15 to educate, promote environmental citizenship and encourage action. As part of an ongoing effort, the school recently created a "Green Team." The group consists of GCDC staff members and representative from Goddard's Medical and Environmental Management Division. The purpose of the team is to identify ways the school can become more environmentally conscious. The goal is to become a Maryland Association of Environmental and Outdoor Education-approved Green School.

With more than 30 years of services in the Goddard community, GCDC is committed to satisfying the diverse needs of families within the community. "At GCDC, we are constantly engaging in activities that teach our students to care for our planet. We teach this important concept in ways that we believe to be meaningful to the children," said Chews. ■

Above: Students at the Goddard Child Development Center sort through "trash" to pull out items that can be recycled. Photo credit: NASA/Goddard/Rebecca Roth

GODDARD CELEBRATES AMERICA RECYCLES DAY

By: Shamara Thornton

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GODDARD WELCOMES, CELEBRATES ASTRONAUT VISIT AND SPACE STATION ANNIVERSARY

By: Dewayne Washington



Astronaut Chris Cassidy visited Goddard on Nov. 19 to share his experience from his recent deployment aboard the International Space Station on Expedition 35.

The occasion also recognized the 15th anniversary of the International Space Station. The Russian module Zarya, designed to provide the station's initial propulsion and power, was the first component placed in orbit, launched Nov. 20, 1998.

Goddard's Deputy Center Director for Technology and Research, Dr. Christyl Johnson, introduced Cassidy to members of the audience. "I love the way the Navy describes some of the specialized skills that Chris was trained in," said Johnson. "Two of my favorite have to be noncompliant ship-boarding and underwater explosives."

During his presentation in the Building 3 auditorium, the veteran of two spaceflights compared flying on the shuttle to his recent Soyuz flight. He showed video of his stay aboard the space station as he talked about living and working in space. Cassidy also talked about adjusting to life after being weightless for five months. There was a question and answer session and time to have your picture taken with him and receive an autograph. Many said it was a great honor to be able to meet the astronaut personally.

Before the presentation, Cassidy was able to spend time talking to some of Goddard's military veterans about the history of military members becoming astronauts. They also talked about the camaraderie that is always a part of military life, during and after active duty.

The Navy Commander and decorated U.S. Navy SEAL, is a graduate of the U.S. Naval Academy in Annapolis, Md. The expert kayaker completed a 180-mile charity paddle from Norfolk, Va. to Washington, D.C. to raise money and awareness for the Special Operations Warrior Foundation. ■

Photo credit: NASA/Goddard/Bill Hrybyk



OUTSIDE GODDARD

By: Elizabeth M. Jarrell

TURNING ON THE LIGHT

Fifteen years ago, aerospace engineer Howard Branch became involved with the Young Men's Mentoring Program at his church, Ebenezer United Methodist Church in Lanham, Maryland. The program works with young men of middle school age.

Branch was invited because of his strong math background. Even 15 years ago, educators were concerned about deficiencies in math education scores. He admits that it took "a little brow beating, arm twisting and a sense of duty—all the usual incentives."

Typically, about a dozen mentors are given eight to ten young men from the public schools local to the church. Each young man is assigned his own mentor.

The mentors and young men meet three Saturdays a month during the academic year. Two Saturdays a month, they meet for three hours of tutoring including a full hour for math. Each mentor teaches a different subject. Branch's subjects are general math and algebra. The third Saturday a month, the group goes on a field trip.

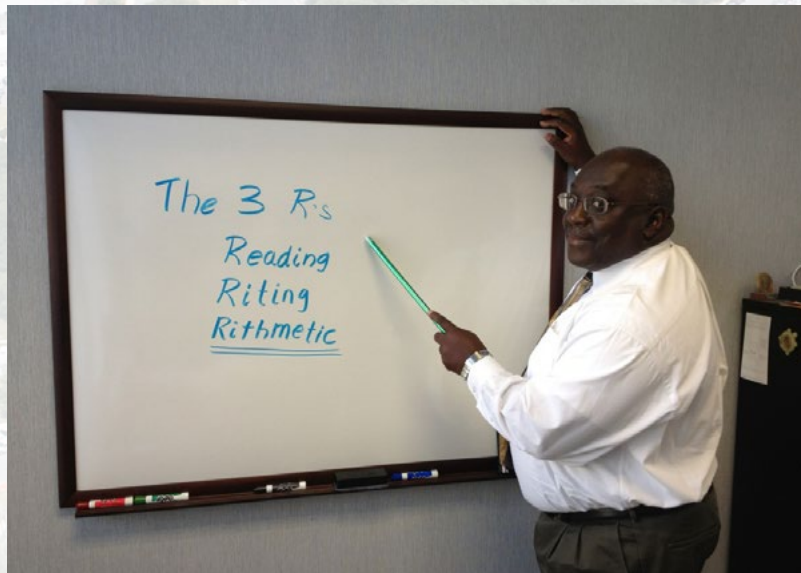
"Some of the kids are more enthusiastic than others, but these kids are not that much different from how my own two were at that age," said Branch. "However, we tend to get young men who do not have an adult male figure in their home."

His first challenge is motivating the kids, many of whom are not interested in learning. Branch tries to get beyond whether or not the kids want to be there by explaining what they are trying to accomplish. The monthly field trips also help motivate the kids. "Fun is a great motivator," said Branch. The field trips open the group to other social settings such as museums, restaurants and sporting events; Friday night basketball; and general conversations about life. Wherever they go, Branch links the field trip to math. "We might discuss Kobe Bryant's scores, which uses their interest in sports figures as a bridge into math," said Branch.

Once motivated, he finds ways to make math easy and exciting. "Everyone gets one-on-one help, which allows us to go painfully through every detail making sure everyone understands," says Branch. "Everyone comprehends at a different speed."

Branch literally pulls out his magic math tricks. "For example, any multiplication of five ends up with a five or a zero on the end," said Branch. "The kids thoroughly enjoy the tricks and want more."

Branch's efforts have paid off. At the beginning of the year, a C in math for the group would be good. By the start of the final quarter, the group's average would often be raised to a B and all students would be passing or better.



"What I am really looking for is seeing the light go on and the youth accepting a sense of responsibility, need and desire to learn. Once this happens, the rest will come along. Turning on the light is the ultimate in my mind," said Branch.

Branch remembers one special success story. This particular student spoke at their end-of-year closing ceremony attended by parents, mentors and local community notables.

"Throughout the year, this one kid always claimed that he knew math well although his actions at the chalkboard indicated otherwise. At the closing ceremony, he recognized that his level of math was still inadequate, but he was mentally ready to go do whatever he needed to do to make the grade. He had gotten it. The light had turned on. I knew then that he was going to be OK, not just in academics, but in life," said Branch.

"In my next career, I may like to be a teacher or school counselor. When I help a young person turn on the light, I know that I have touched him or her where the rubber meets the road; it is a meaningful connection," said Branch. ■

Center: Howard Branch reviews the basics. Photo provided by Howard Branch